CLAIMS

What is claimed is:

1. A combustion system for use in a turbine which combusts a fuel in the presence of an oxidizer that substantially eliminates nitrous oxide emissions, comprising:

a heat exchanger including:

a first member defining a catalyst pathway extending along a first axis;

a second member defining a cooling pathway extending along a second axis;

wherein said catalyst pathway is in thermal contact with said cooling pathway;

a catalyst, disposed within said catalyst pathway and adapted to combust the fuel with the oxidizer; and

wherein the oxidizer is adapted to at least one of first flow past said catalyst pathway and through said cooling pathway to thereby receive thermal energy from said catalyst pathway.

2. The combustion system of claim 1,

wherein said first member comprises a plurality of catalyst members, which form a plurality of catalyst columns each spaced apart transversally to said first axis and which define a plurality of channels adapted for allowing the air to flow therethrough;

wherein said second member comprises a plurality of cooling tubes that form a plurality of cooling tube columns each spaced apart transversally to said second axis; and

wherein said cooling tubes extend substantially adjacent said catalyst members along said second axis for at least a portion of the length of said catalyst members.

3. The combustion system of claim 2, wherein said catalyst members, said cooling tubes, and said channels together define a flow path for the oxidizer such that the oxidizer is able to receive thermal energy from the catalyst members by flowing through said channels and said cooling tubes.

4. The combustion system of claim 1, wherein said catalyst comprises a material able to combust a fuel in the oxidizer below about 1500° C.

5. The combustion system of claim 1, further comprising:

a heat exchanger;

a pre-mix area for mixing a first portion of the fuel with the air;

a main injector area comprising at least one injector for said catalyst members;

wherein said main injector is operable to mix a second portion of the fuel with the oxidizer such that the temperature throughout the area of the injector is substantially equal.

6. The combustion system of claim 5, wherein said main injector is operable to inject the fuel that includes at least one of a methane gas, a natural gas, a carbon based gas, a hydrogen gas, a Synthesis gas, and combinations thereof.

7. The combustion system of claim 5, wherein said main injector is operable to inject at least two of the fuel including methane, hydrogen, natural gas, carbon based fuels, and combinations thereof.

8. The combustion system of claim 5, wherein said main injector is operable to inject a first fuel during a first time period and a second fuel during a second time period.

9. The combustion system of claim 8, wherein said first fuel and said second fuel include a substantially similar injector momentum.

10. The combustion system of claim 1, further comprising fins adapted to direct the flow of air around said catalyst tube.

11. The combustion system of claim 1, wherein said cooling pathway includes a cooling fin and said catalyst pathway includes a catalyst fin.

12. The combustion system of claim 1, wherein said first axis and said second axis are parallel for at least a portion of said catalyst pathway and said cooling pathway.

13. A combustion system for a turbine, comprising:

a compressor adapted to produce compressed atmospheric air;

a combustion system for mixing and combusting a fuel injected into the compressed atmospheric air to produce expanding gases;

a turbine which is powered by the expanding gases:

wherein said combustion system comprises:

a first fuel supply to supply fuel to the compressed atmospheric air;

a heat exchanger comprising a catalyst section including a catalyst disposed within said catalyst section, wherein the compressed air and the fuel flow through said catalyst section; and

a second fuel supply to supply fuel to the compressed atmospheric air after the compressed atmospheric air has passed through said catalyst section.

14. The turbine of claim 13,

wherein said catalyst section comprises a plurality of said catalyst members each extending along a first axis;

wherein said heat exchanger further includes a plurality of cooling tubes each extending along a second axis generally parallel to said first axis for at least a selected length;

wherein said catalyst members are arranged to form a plurality of columns spaced transversally to said first axis and defining a plurality of channels; and

wherein said cooling tubes are arranged in a plurality of columns and extend a distance along said catalyst members and generally perpendicular to said channels.

15. The turbine of claim 14, wherein said catalyst members, said cooling tubes and said channels define a flow path for the compressed atmospheric air such that the compressed atmospheric air is adapted to receive thermal energy from said catalyst members by flowing through said channels and said cooling tubes.

16. The turbine of claim 14, wherein thermal energy is transferred to the compressed atmospheric air as it flows through said heat exchanger such that the fuel from the first fuel supply is combusted via said catalyst.

17. The turbine of claim 14, further comprising:

a heat exchange area;

a pre-mix area for mixing a first portion of the fuel with the air;

a main injector area comprising at least one injector for said catalyst tube;

wherein a second portion of the fuel is mixed with the compressed atmospheric air in said main injector; and

wherein said main injector is adapted to mix the second portion of fuel with the compressed atmospheric air such that the temperature throughout the area of the injector is substantially equal.

18. The turbine of claim 17, wherein said main injector is operable to inject a fuel, including at least one of a hydrogen, a methane, a natural gas, a carbon based fuel, a Synthesis gas, and combinations thereof.

19. The turbine of claim 17, wherein said main injector may inject at least two different fuels at different times with substantially similar results.

20. The turbine of claim 17, wherein said at least one injector includes a plurality of injectors, wherein said plurality of injectors substantially mix at least one of a methane fuel, a hydrogen fuel, a Synthesis fuel, a natural gas fuel, and combinations thereof with the oxidizer.

21. The turbine of claim 13, wherein said catalyst section comprises a catalyst fin.

22. A method of combusting a fuel in a combustor in the presence of atmospheric air while substantially eliminating the emission of nitrous oxide compounds from the combustor, the method comprising:

providing a heat exchanger comprising a plurality of pathways;

disposing a catalyst in at least a sub-plurality of said pathways;

forming a first fuel-air mixture by mixing a first portion of the fuel and the air;

producing a auto-ignition air stream by combusting the first fuel-air mixture by contacting the first fuel-air mixture with the catalyst; and

heating the air by transferring a portion of thermal energy from the pathways to the air.

23. The method of claim 22, further comprising:

forming a second fuel-air mixture by adding a second portion of fuel to the auto-ignition air stream; and

producing an expanding gas by combusting said second fuel-air mixture, said expanding gas occurring when the fuel in the second fuel-air mixture reaches the temperature of the auto-ignition air stream.

24. The method of claim 23, further comprising powering a turbine with said expanding gas.

25. The method of claim 22, wherein said first fuel-air mixture has an equivalence ratio of between about 0.10 and about 0.30.

26. The method of claim 23, wherein said second fuel-air mixture has an equivalence ratio of between about 0.40 and about 0.60.

27. The method of claim 22, wherein said auto-ignition air stream has a temperature between about 760° C (1400 ° F) and 871° C (1600 ° F).

28. The method of claim 22, wherein the step of heating the air comprises transferring a portion of the thermal energy produced in the pathways when the catalyst forms the auto-ignition air stream.

29. A combustion system for use in a gas powered turbine which combusts a fuel in the presence of an oxidizer while substantially eliminating nitrous oxide emissions, comprising:

a pre-heater to heat a volume of an oxidizer to form a volume of high energy oxidizer;

an injector member to inject a fuel into said volume of high energy oxidizer;

an injector port, defined by said injector member, to provide the fuel to said volume of high energy oxidizer before a substantial portion of the fuel combusts; and

wherein the fuel has an auto-ignition temperature and substantially all the fuel provided through said injector port reaches its said auto-ignition temperature at substantially the same time.

30. The combustion system of claim 29, wherein said pre-heater includes:

a catalyst pathway having a catalyst disposed therein; and

a cooling pathway;

wherein said catalyst pathway and said cooling pathway extend substantially parallel for a selected distance.

31. The combustion system of claim 30,

wherein said catalyst pathway comprises a plurality of catalyst members that form a plurality of catalyst columns each spaced apart transversally to said first axis and which define a plurality of channels adapted for allowing the oxidizer to flow therethrough;

wherein said cooling pathway comprises a plurality of cooling tubes that form a plurality of cooling columns each spaced apart transversally to said second axis; and

wherein said cooling columns extend substantially adjacent said catalyst columns along said second axis for at least a portion of the length of said catalyst columns.

32. The combustion system of claim 29, further comprising:

at least a first and a second of said injector ports;

a first fuel stream produced by said first injector port; and

a second fuel stream produced by said second injector port;

wherein said first fuel stream and said second fuel stream impinge into one another to form a fuel plume prior to intersect the high energy air.

33. The combustion system of claim 32, wherein said first fuel stream and said second fuel stream intersect at an angle between about 20° and about 150°.

34. The combustion system of claim 32, further comprising:

a fuel path formed in said injector member such that the first fuel stream and the second fuel stream provided by said first and second injector ports intersect to produce said fuel plume.

35. The combustion system of claim 29, wherein said injector port is substantially rectangular in shape such that a fuel stream is flattened as said fuel stream exits said injector port.

36. The combustion system of claim 29, wherein the fuel is at least one of a methane, a hydrogen, a natural gas, a Synthesis and combinations thereof.

37. The combustion system of claim 29, wherein the fuel includes a first fuel and a second fuel that are to be used at different times;

wherein said first fuel and said second fuel are different.

38. A gas powered turbine, comprising:

a compressor to produce compressed atmospheric air to provide an oxidizer for the gas powered turbine;

a combustion system for mixing and combusting a fuel injected into the compressed atmospheric air to produce an expanding gas;

a turbine fan which is powered by the expanding gases:

wherein said combustion system comprises:

a pre-heat area;

a first fuel line to supply a first portion of fuel to the compressed atmospheric air which is combusted in the pre-heat area to heat the compressed atmospheric air to a hypergolic temperature so as to produce hypergolic air;

a second fuel line to supply a second portion of fuel to the hypergolic air;

an injector system to provide said second portion of fuel to said hypergolic air before any substantial portion of said second portion of fuel combusts; and

wherein substantially all of said second portion of fuel combusts at substantially the same time such that the gas powered turbine emits substantially no nitrous oxide compounds.

39. The turbine of claim 38, further comprising:

the air before the air enters the pre-heat area;

a main injector plate comprising at least a first and a second of said injectors; and

a combustion area wherein said second supply of fuel is combusted.

40. The turbine of claim 39, further comprising:

a first fuel stream produced by said first injector port; and

a second fuel stream produced by said second injector port;

wherein said first fuel stream and said second fuel stream impinge into one another forming a fuel plume prior to intersecting the hypergolic air.

41. A method of combusting a fuel for a gas powered turbine in the presence of atmospheric air while substantially eliminating the emission of nitrous oxide compounds, the method comprising:

producing an auto-ignition air stream wherein a fuel homogeneously combusts spontaneously upon reaching the temperature of said auto-ignition air stream;

providing a first portion of the fuel to said auto-ignition air stream; and

mixing said first portion of fuel with said auto-ignition air stream before substantially any of said first portion of fuel combusts to substantially eliminate emission of nitrous oxide compounds.

42. The method of claim 41, further comprising:

producing an expanding gas by combusting said first portion of fuel in said auto-ignition air-stream, said expanding gas occurring when said portion of fuel in said auto-ignition air-stream combusts upon reaching the temperature of the auto-ignition air stream.

43. The method of claim 42, further comprising powering a turbine with said expanding gas.

44. The method of claim 41, wherein said auto-ignition air stream has a temperature between about 760° C (1400 ° F) and 871° C (1600 ° F).

45. The method of claim 41, wherein mixing said first portion of fuel further comprises:

impinging a first fuel stream upon a second fuel stream to form a fuel plume.

46. The method of claim 45, wherein impinging said first fuel stream upon said second fuel stream occurs at an angle between about 20° and about 150°.

47. The method of claim 46, further comprising:

forming said first fuel stream and said second fuel stream as substantially flat streams before allowing said streams to impinge one another.

48. The method of claim 41, wherein mixing said first portion of fuel further comprises providing a substantially flat fuel stream to said auto-ignition air stream.

49. The method of claim 41, wherein producing an auto-ignition air-stream further comprises:

forming a fuel-air mixture by mixing a second portion of fuel with a volume of air; and

combusting said second portion of fuel in said volume of air, wherein combusting said second portion of fuel increases the temperature of said volume of air to an auto-ignition temperature.

50. A combustion system to combust a fuel with an oxidizer, comprising:

a first flow pathway disposed substantially in a first plane;

a second flow pathway disposed substantially in said first plane; and

an interconnection between said first pathway and said second pathway;

wherein a flow of a fluid flows in a first direction in said first pathway and in a second direction in said second pathway;

wherein said interconnection assists said flow in changing direction from said first pathway to said second pathway.

51. The combustion system of claim 50, further comprising:

a first member defining said first flow pathway through said first member; and

a second member defining said second flow pathway through said second member;

wherein said flow is substantially restricted to be within said first member while in said first pathway and in said second member while in said second pathway.

52. The combustion system of claim 51, wherein said first and second members include a plurality of substantially square tubes positioned in thermal transfer proximity to one another.

53. The combustion system of claim 52, wherein a catalyst is disposed in at least one of said first member and said second member such that said catalyst may engage the flow therethrough.

54. A combustion system for a gas powered turbine to combust a fuel with an oxidizer to form a gas, the combustion system comprising:

a premix section to mix a first selected volume of the fuel with the oxidizer;

a main combustion chamber;

a heat exchanger to heat the oxidizer prior to the mixing with the first selected volume of the fuel, including:

a plurality of catalyst tubes extending along a first axis to direct a flow of the oxidizer to said combustion chamber;

a plurality of cooling tubes extending along a second axis;

wherein said plurality of cooling tubes direct the flow of the oxidizer in a first direction and said plurality of catalyst tubes direct the flow of the oxidizer in a second direction after the oxidizer is mixed with the first volume of the fuel.

55. The combustion system of Claim 54, wherein said cooling tubes may extend into said pre-mix section to discreetly define a flow of the oxidizer into said pre-mix section.

56. The combustion system of Claim 54, further comprising:

a catalyst operable with said catalyst tubes to combust said first selected volume of the fuel as the first selected volume of the fuel flows through said catalyst tubes.

57. The combustion system of Claim 54, further comprising;

a main injector;

wherein said main injector is operable to inject a second selected volume of the fuel into said main combustion chamber.

58. The combustion system of claim 57, wherein said main injector is operable to inject a fuel including at least one of a Synthesis, a hydrogen, a methane, a natual gas, a carbon based fuel, and combinations thereof.

59. A combustion system of claim 57, wherein said main injector is operable to inject the fuel before substantially any of the fuel reaches an auto-ignition temperature.

60. The combustion system of claim 59, wherein the fuel includes a first fuel and a second fuel, wherein said first fuel and said second fuel are different.